



Broadcast Audio— The Increased Need for Audio Processing

ROBERT L. DEITSCH and GEORGE BERGER

Here, authors Deitsch and Berger provide us with a behind-the-scenes look at the problems (and the solutions) faced by engineers in the broadcast field.

THIS ARTICLE will deal with the basic concepts which underlie the design of facilities for the ABC radio broadcast studios in New York. Since 1975, when a slow but major reconstruction was begun, we have argued with our friends about what we believe are the fundamental and philosophically different aspects of broadcasting which distinguish it from the rest of the audio field. There are to this day several misconceptions about what broadcast audio is and ought to be, which still disturb audio professionals and amateurs alike.

Is there any reason why that which is broadcast should be identical to the original source? Well, there are two parts necessary to the answer. The first, and we grant some nit-picking, is that none of the records and tapes which are our primary sources are unprocessed, and secondly, shouldn't the broadcaster be granted latitude in the same sense in which recording engineers use processing to compensate for the limitations of their media or to create a uniqueness of sound for a group? We suggest that to answer no is intellectually dishonest, and thus we have ceased to feel any necessity to defend

our position. We must make it understood, but the proof comes from that understanding *a priori*.

Our somewhat dogmatic philosophy about our studios is that an on-air control room should be as specifically tailored to the format as possible, and that a production facility must be so general and versatile that it never limits the creativity of either the producer or technician. Technical equipment should be of the highest possible quality. All of our installations since 1975 have been centered around custom-designed mixing desks from Rupert Neve, all reel-to-reel tape decks have been Studer A-80 mastering recorders.

It would be unfair for the reader familiar with the two ABC-owned radio stations in New York to be saying, "What a waste of good facilities: by the time I hear the product it sounds very different." The AM station is WABC which, over the years, has been the premier clear channel station in the U.S. ABC's FM station in New York is WPLJ, which is the top-rated album rocker in New York. The two stations provide some excellent examples of the use of audio processing within our medium.

EASE VERSUS QUALITY

One of the problems broadcasters have faced since the early sixties has been the conflict between the desirability of using tape cartridges for ease of production and the degradation of quality, especially in stereo, which seemed to be inherent in using them. The two major problems were phasing and degradation of signal-to-noise ratio. As early as 1973 we were experimenting with a matrix encoding system to minimize

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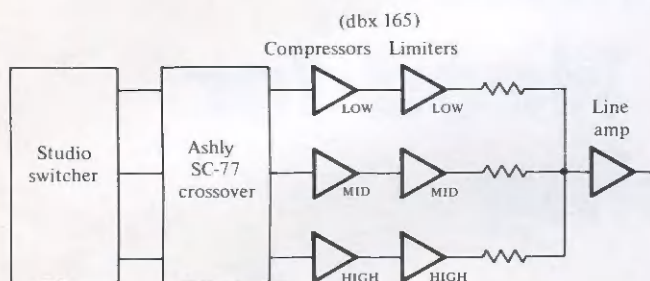
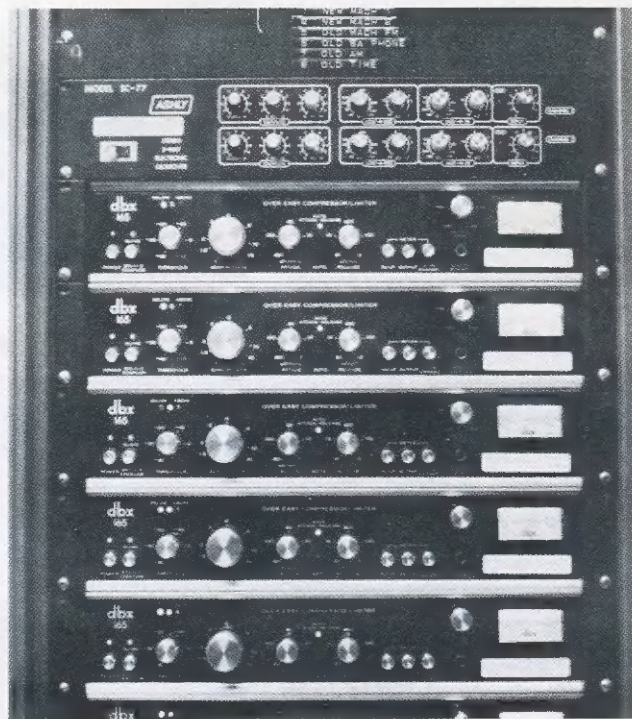


Figure 1. WPLJ's "better mousetrap" consists of an Ashly SC-77 Crossover and six dbx model 165 "Over Easy" Compressor/Limiters. (A) Block diagram; (B) rack-mounted equipment.



phase instability. In 1975 we decided to use dbx® noise reduction as well.

There has been much debate over the relative merits of dbx and Dolby noise reduction. Because so much of the source material we use comes to us already compressed, and also because dbx offers a far greater amount of noise reduction to precede the additional compression which we use, dbx was to us a far preferable choice. Both of our stations now use this combined processing system. This type of processing should be transparent; the listener, either in the studio or at home, should not be able to detect its presence.

The type of processing which causes controversy is compression, limiting, and clipping, as well as any equalization or reverb which may be added. It should be realized that the "sound" of a radio station is an important programming consideration. Psychoacoustic analysis is one of the elements which enters into such decisions, but the broadcaster must also consider competitive loudness and dynamic range.

Many listeners are in environments with high ambient noise levels, such as automobiles; a station can ignore this part of its potential audience only at its peril. On the other hand, if listeners find the signal unenjoyable because too much processing is added to "fix" this type of problem, audience may also be lost. Consequently, the final decisions, within the limits imposed on all broadcasters by the FCC rules and regulations, must be made among what are still a scientifically ill-defined set of possibilities. Having made those tough choices, the broadcaster must enter into the area of receiver technology in order to determine how to best accomplish those aims.

It is reasonable to look at the FM broadcast chain, including the home receiver, as offering the potential of true reproduction. But it is by no means true that all FM receivers can reproduce what is in the broadcast signal with true high fidelity. Thus, even with FM, the broadcaster must attempt the clearest possible definition of the audience. With AM, the waters become much more murky. AM transmission is for all practical

purposes capable of equal fidelity! It is, of course, subject to atmospheric and electrical interference, but the broadcast signal is high fidelity. THD and IMD figures of less than one percent are achievable. Signal to noise ratio approaches 60 dB. Today, most AM receivers begin to roll off frequency response at 1 kHz and are down more than 6 dB by 5 kHz.

In defense of receiver manufacturers (but certainly not to agree with them), it is, of course, more expensive to build wide response high fidelity AM receivers. Most firms claim that there is no mass market for such equipment. We as broadcasters counter that this is a matter of consumer education; there was no immediate large-scale rush to FM equipment either.

So, we the broadcasters are left attempting to compensate for the varying quality of receivers, both AM and FM, that are in the hands of the public. Both of our New York stations play "popular" music. The problem faced by the technical staff to meet the desires of the WABC programming department is to provide a sound which makes WABC-AM sound as good on the radio as an FM station. This means that we must compensate for the "poorer" AM circuitry in AM/FM combination radios and receivers.

Through experimentation, we have found that no single equalization curve can accomplish our purpose. The single most obvious objection to a simple equalization attempt comes from the announcers and disk jockeys. They feel that they don't sound like themselves. They are correct. We have found that a multiband compressor/limiter system has been the answer.

Many of the ideas for use of equipment start at our visits to Audio Engineering Society conventions. For example, we were extremely impressed with the "Over Easy®" compression curve used in some dbx equipment. Many years of experience have taught us that the use of any single band compression device does not yield the desired audio density without destroying the clarity of tone at the lower and higher ends of the frequency spectrum. Such single-banded attempts typically yield muddy drums and cymbals.

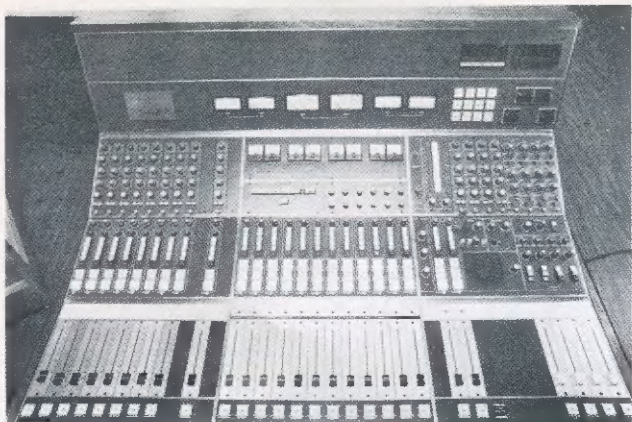
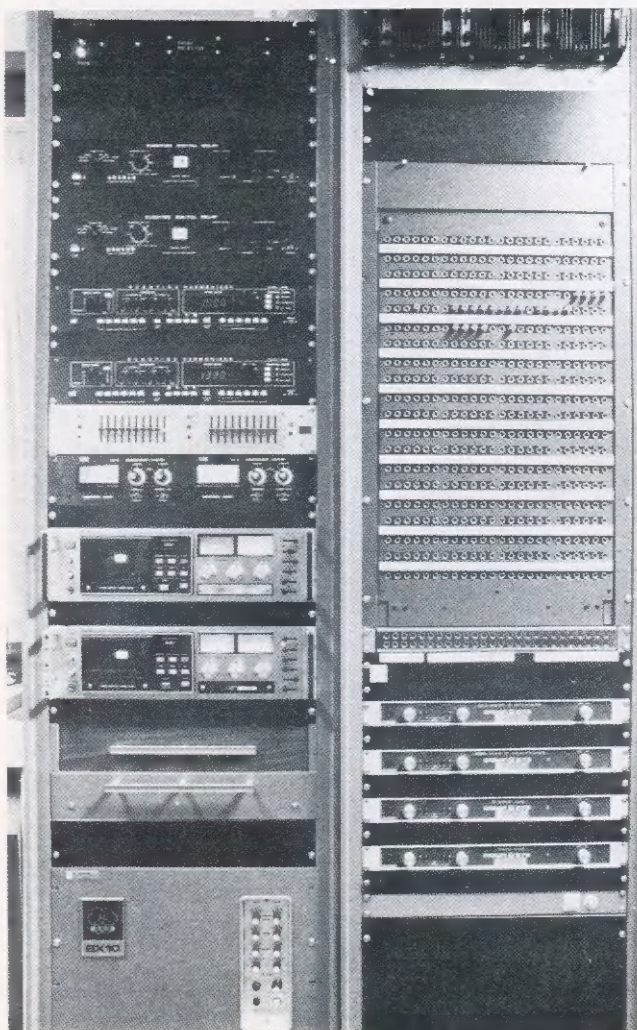


Figure 2. Custom-designed Neve boards. (A) Studio 8C; (B) Studio 8X.

Figure 3. The equipment rack in Studio 8C.



For many years, WPLJ-FM has used Dorrough discriminate audio processors. But all of our attempts to use them and other readily available tri-band processors on AM had yielded, what were to us, unsatisfactory results. We knew that it was relatively easy to make music sound good, but found that the quality of voices was changed too much. Finally, we bit the bullet and decided to attempt to build a better mousetrap out of commercially available components.

BUILDING THE PROVERBIAL MOUSETRAP

We found that an Ashly crossover with setttable depth and 12 dB/octave crossover curves was best. Steeper curves didn't sound as good to us. We wanted to assemble a tri-band processor with compressor and limiter in each band to use in our air chain at the studio, plus a single processor for final gain compensation at our transmitter. A separate compressor and limiter is used in each frequency band to achieve a uniformly loud sound without pumping.

The dbx 165 offers a number of advantages beyond the fact that we liked its sound. It can be coupled for stereo, which probably is coming to AM. It turns out to be extremely important that it has user access to the limiter sidechain. It also offers externally accessible automatic or variable attack and release times, infinitely variable compression ratio, and adjustable level threshold.

The crossover is adjusted to split the frequency spectrum optimally to allow the compressor/limiter pairs to be set for thumping lows, clear midrange, and crisp highs. For most formats, we feel that two crossover points are sufficient. For disco, one might want to add an extra band for very low frequencies. We feel that different formats will be helped by adjustment of both crossover points and depth. Delay and equalization are inserted into the side chain to eliminate phase-related interactions of the recombined audio. Small amounts of delay added to the side chain signal can achieve some remarkable results. Equalization can, for example, aid in de-essing; this is important before clipping when attempting to maximize loudness in the baseband. A truly flat AM signal yields a muddy sounding AM signal because of receiver design. We have achieved a psychoacoustically pleasing sound which simulates wideband reception on most AM receivers.

The program director of WPLJ wants a compressed sound. This is achieved using a Dorrough 310C discriminate audio processor with modified recovery times, Moseley limiters, and composite clipping. When composite clipping is used, the broadcaster must adjust it so that he can pass an FCC proof-of-performance with it in the circuit as it is for everyday transmission. WPLJ is the loudest FM station in New York.

We have designed our technical facilities to allow for rapid modification of air sound. We are proud of the quality of our plant and of our ability to provide the sound required by our programmers. ■

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